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NOT TEN BUT TWELVE!

THERE has come to my hands a petition in the form of an open "Letter to Lord Balfour" ("Chairman on Weights, Measures, Coinage, etc."), circulated in the name of the "World Trade Club," and calling upon "United States American President, His Excellency Woodrow Wilson, United States American Congress, etc.," and "British Premier, His Excellency David Lloyd George, Houses of Parliament, etc.," for "legislation, promulgation, Orders in council that will bring about the exclusive use of Meter-Liter-Gram by the United States of America" and "The British Isles."

As the matter is of far-reaching scope and prime importance, may I be allowed a word of earnest protest.

The reasons advanced in the fifteen pages of argument, on disregarding the ill-advised and ill-founded appeal to national prejudice against the alleged Germanic character of our present system (or chaos), amount merely to the oft-repeated affirmation that the metric system, being consistently decimal, is far simpler, more convenient, and time-saving than any non-decimal system, since reductions from unit to unit are made merely by shifting the point, as in dollars and cents. That herein lies a certain very considerable convenience is not denied in any quarter and needs no detailed exposition. Also the advantage of world-wide uniformity in weights, measures, and coinage are plain and uncontested. But this latter fact is no reason for the Anglo-Saxon world to pass over to the Latin-German system, rather than for the latter to yield to some far superior system of the former. While conceding all that may be said with any show of reason in favor of a decimal system, we must not forget nor disguise the very grave disadvantages that inhere ineradicably in it, especially in its cum-

brous expression of many simple, important, and frequent fractions, as 1/3, 1/4, 1/6, 1/8, 1/9, 1/12, etc. We protest most earnestly against the adoption of the Latin-German system, not because it is not better than our present lack of all system, but because such adoption would *postpone perhaps forever the introduction of a far superior system,* which is a capital desideratum of our modern civilization and life. The meter-liter-gram is at least in some ways comparatively good, but the good is the enemy of the best, with which only we can rest content, and it would be an infinite blunder to establish and eternize such a defective system as the M.L.G. when it is almost as easy—at least, when it is entirely possible—to introduce and establish once and for all time the best system that the nature of number and of the human mind permits.

This best of numerical systems is not the ten-system (which is recommended only by the fact that man has ten fingers and ten toes!) but the twelve-system, whose virtues are imbedded in the nature of number itself. Its notation requires at once the introduction of *two new symbols,* one for ten, one for eleven, which may be made as pretty and simple as you will, but the initials *t* and *e* will answer all present purposes. We shall have then the ciphers: 1, 2, 3, 4, 5, 6, 7, 8, 9, *t, e.* Twelve is then to be written 10, and we shall have the next set; 11, 12, 13—19, 1*t,* 1*e,* 20—to be read tel-one, tel-two, tel-three, . . ., tel-nine, tel-ten, tel-len, *twentel.* The reasons for such names are obvious, *tel* and *len* are natural simplifications of twelve and eleven. Our present forms, such as sixteen, seventeen, which read the numbers 16, 17 *backwards,* are a stumbling-block to beginners, hindering and confusing them to no purpose whatever. Twentel (20) equals of course our present twenty-four. Similarly thirtel-one, etc., fortel, fiftel, sixtel (sistel), sentel (for seventel), eightel, ninetel, tentel, lentel, teltel. This last, 100, equal to our present 144, is of course the second power of the base twelve (10), and should have some appropriate name, as *dipo,* or *two-po,* or whatever may seem best, and similarly the higher powers, as 1000(1728), 10,000(20,736, etc.). We see here at once the greater *power* of this system; with four figures it expresses numbers up to 20,735 (e e e e in the twelve-system), more than twice as many as are so expressible at present—an advantage that steadily increases with the numbers, and shows itself clearly in logarithmic and other tables, where, with the same number of figures, the accuracy of expression would be sensibly higher. Thus, a unit in the sixth decimal place now signifies a millionth, in the Tel-system it would mean about a three-millionth. In the billions, the Tel-notation economizes one place.

Among the many advantages shared by this system with no other, the chief is the high factorability of the base twelve, divisible exactly by 2, 3, 4, 6, and simply related to 8 and 9. Thence result extremely simple expressions for the principal fractions:

1/2 = .6
1/3 = .4
1/4 = .3
1/6 = .2
1/8 = .16
1/9 = .14
one twelfth = .1
1/14 = .09
1/16 = .08
1/20 = .06, etc.

The fractions 1/5, 1/7 one tenth, one eleventh (111 . . . .) remain interminate series, but for them we have little practical use. With the foregoing compare the current decimal expressions for the fundamental constantly recurring fractions:

1/2 = .5
1/3 = .33333 - - -
1/4 = .25
1/6 = .16666 - - -
1/8 = .125
1/9 = .111
one twelfth = .08333 . . .

and the great superiority of the tel-system becomes evident.

The multiplication table[1] becomes markedly simplified. No one has any trouble now in multiplying by 5, because of its simple cycle, 5, 0 (as in 5, 10, 15, 20, etc.): 4 has the much longer, more involved cycle, 4, 8, 2, 6, 0, (as in 4, 8, 12, 16, 20, etc.); 6 has the cycle 6,

2, 8, 4, 0 (6, 12, 18, 24, 30); 8, the cycle 8, 6, 4, 2, 0. Compare with these the cycles in the Tel-system: 2(2, 4, 6, 8, t, 0), 3(3, 6, 9, 0), 4(4, 8, 0), 6(6, 0), 8(8, 4, 0), 9(9, 6, 3, 0), and the surpassing simplicity of this system is again apparent. A child will learn this multiplication table with much less effort than

11	2	3	4	5	6	7	8	9	*t*	*e*
2	4									
3	6	9								
4	8	10	14							
5	*t*	13	18	21						
6	10	16	20	26	30					
7	12	19	24	2*e*	36	41				
8	14	20	28	34	40	48	54			
9	16	23	30	39	46	53	60	69		
t	18	26	34	42	50	5*t*	68	76	84	
e	1*t*	29	38	47	56	65	74	83	92	*t*1

1	2	3	4	5	6	7	8	9
2	4							
3	6	9						
4	8	12	16					
5	10	15	20	25				
6	12	18	24	30	36			
7	14	21	28	35	42	49		
8	16	24	32	40	48	56	64	
9	18	27	36	45	54	63	72	81

Compare these two multiplication tables. In the ten-table the end digits are: 0, 4 times; 1, 2 times; 2, 5 times; 3, 1 time; 4, 6 times; 5, 4 times; 6, 6 times; 7, 1 time; 8, 5 times; 9, 2 times. In the tel-table the end-figures in the corresponding products are: 0, 8 times; 1, 2 times; 3, 3 times; 4, 6 times; 6, 6 times; 8, 4 times; 9, 4 times; *t*, 2 and *e* each 1 time; 5 and 7, not at all, though each occurs once of course, in the products of e. Notice the much greater simplicity, due to their absence and to the presence of 0, 8 times. Notice also the simplicity in the squares, and the double central symmetry in 1, 4, 9, 4, 1, 0, 1, 4, 9, 4, 1, and compare with the 1, 4, 9, 6, 5, 6, 9, 4, 1 of the ten-table, also an anagram but with only single symmetry, and with 5 different digits against only 4 in the tel-system, which is thus notably simpler.

the ten-table, and will find the range of its power and the scope of his attainment just 44 per cent. greater (since 100 in the tel-system = 144 in the ten-system).

The year is divided into twelve months, and no other division is likely within any forseeable time. Accordingly, in time-reckoning the advantages of the tel-system are obvious. In this notation the number of days in the year is 265. To each month we should by all means assign the same number of days, thirty (30) as now or twentel-six (26) in the tel-system: that is, 260 month-days in all; the remaining 5 should be extra-mensual, legal holidays, easily and instructively distributable over the year, with a sixth such in leap years. Monthly and annual accounts and rates would be turned into each other by merely moving the point one place to right or left. If one received $100 a month, one would receive $1,000 a year; if the interest rate was 6 (per dipo) per year, it would be .6 per month. Similarly the day is already divided into (twice) twelve hours, that is, 20 in the tel-system. The circle (or round angle) is now divided into 360 degrees (or 250 in the tel-system); this Babylonian division is unfortunate but may be easily conformed to the divisions of the clock-face into twelve parts, each of these divided into twelve (stretches of 5 minutes or of 2 1/2 degrees), each of these into twelve again, and so on. With our established time-divisions the ten-system can never be harmonized.

The better unit of coinage is the American quarter, the English shilling (German mark). The dollar is too large, a fact in some measure responsible for the sinful and ruinous extravagance of American life. The shilling is already divided into twelve pence, a division that admits of no improvement; it remains only to be consistent and to coin the twelve-shilling piece (a convenient coin, which might be named twilling or tel-quar); with its fractions and multiples, which Anglo-American commerce would spread all over the earth. So, too, the foot is already divided into twelve inches. To convert inches and feet into each other, it would be necessary only to move the point.

The meter has no superiority over the yard;

if the latter be taken as standard, it should be divided into twelfths (or telths), and these again into twelfths, etc. The mile might be slightly reduced to 1,728 yards (in the tel-system 1,000 yards, 3,000 feet). All such details and all proper preliminaries to the passage from ten to twelve could be worked out by scientific committees appointed for the purpose, once the number twelve is laid at the base of our numeration, notation and all forms of measurement—a position for which it is uniquely fitted.

One and only one objection can be made to this proposal, namely, that it is impractical, infeasible and visionary. We dare not answer with the favorite Scripture, "Where there is no vision, the people perish," for this sentiment alas! is foreign to the Hebrew proverb. But the objectors themselves reject with scorn the similar objection to the introduction of the metric system, that it is impractical and visionary and could only with great difficulty be effected. It is the stock objection of all conservatism, the objection that confronts every effort to rationalize, humanize, beautify, glorify and justify our life on earth, the objection that it can not be done! The same has been said of a hundred proposals, all declared unrealizable, and all now actually realized. It may be hard to answer Zeno's arguments against the possibility of motion, but it is none the less easy to move! So it will be with the change from ten to twelve. Attempted, it will be accomplished. Not in a day or a year, but at most in a generation. Let the children be taught the tel-system year after year. The time necessary to learn it will be quite inconsiderable. Once learned, it will also be loved. In the meantime scientific commissions can go over the whole ground carefully and prepare the way in the wilderness and level up in the desert a road for the age to come. When the change is finally carried into effect, the jar of switching off the ten-track to the twelve-track will be much less severe than we now imagine. But it will bring incalculable blessings to all future generations. The great giant arithmetic will be shorn of half his terrors. It is very common in these loud-mouthed days to make Brobdingnagian pretensions. We are told that each of a score of trifles (base-ball among them) won the war, when each made only a paltry contribution to the collective result. So we are assured that each of many things would have abridged the war by months or years. The World Trade Club informs us that had Congress adopted the "meter-liter-gram legislation before Congress (1904), the war would have been shortened two years." If a few other such things had been done, perhaps the war would have been stopped like Buck Fanshaw's riot, before it was started or even imagined! As such indebtedness heaps up on all sides, one is reminded of the famous couplet:

> Owen More has run away,
> Owin' more than he can pay.

We are further assured that

> Clyde Wolfe, Master Mathematician, University of California, writes: A conservative estimate is that the exclusive use of meter-liter-gram would shorten the time of teaching arithmetic to the average child by 2 years.

If so, then the substitution of twelve for ten as a base ought to shorten it by at least four years. No such claim is made here, but it is affirmed that a very large and sorely needed saving of time and energy would be effected, and that if the introduction of the thoroughly rational twelve-system should be supplemented by the adoption of a thoroughly rational alphabet, with one-to-one correspondence of sign and sound, then would the words of the English language indeed be winged and fly over all the earth, then would our Anglo-American civilization lead the van of progress, and its commerce would fulfil the boast of its poet:

> Trade is the golden girdle of the globe.

William Benjamin Smith

A NATIONAL INSTITUTE OF NUTRITION

In a recent issue of Science (August 1, 1919) Lusk calls attention to a reconstruction problem which seems in danger of receiving less consideration than its fundamental significance demands, viz., the food problem, vital